April 17, 2004

United States Patent and Trademark Office
Commissioner for Patents
P.O.Box 1450
Alexandria, VA 22313-1450
Attn: Art Unit 3713, Kim Nguyen

Re: Application Number 10/034,786

To Whom It May Concern:

Enclosed is our reply to a Non-Final Office Action (mailing date 12/22/03) on the above Patent Application. We previously filed a request for a one-month extension of time to apply. Thank you for your consideration.

Sincerely,

Eugene B. John

Heinrich D. Foltz

Image 4-21-04 3713



# Reply to Office Action Dated 12/22/2003

**Application Number:** 10/034,786

**Applicants:** JOHN ET AL.

**Examiner:** Kim Nguyen

**Art Unit:** 3713

**Application Title:** Method and Apparatus for Location of Objects, and Application to Real Time Display of the Position of Players, Equipment and Officials During a Sporting Event

**Attachment:** List of Claims, Revised

## Section 1. Summary of Reply

- We accept the examiner's rejection of Claims 1, 12, and 14-21 and request cancellation of these claims (see Section 4 below). We propose corrections and clarifications to Claims 2-11 and 13.

- The examiner objected to Claims 2, 4, and 20 due to informalities. We accept all of the corrections to Claims 2 and 4 indicated by the examiner (see Section 2 below). We propose to cancel Claim 20 entirely.

- The examiner rejected Claims 1-13, 17, 19, and 21 due to ambiguities and indefiniteness. We agree that there was ambiguity. In response we propose corrections to Claims 1-11 and 13 (see Section 3 below), and respectfully request the examiner's reconsideration. We request cancellation of Claims 12, 17, 19, and 21.

- The examiner rejected Claims 1 and 3-13 under 35 USC §103(a). We accept the rejection of Claims 1 and 12, and request that they be cancelled. We propose clarification of Claims 3-11 and 13, and respectfully request the examiner's reconsideration with the clarifications.

- The examiner rejected to Claim 2 under 35 USC §103(a). We believe that with further clarification, which we propose, Claim 2 is distinguishable from prior art and is nonobvious. We respectfully request the examiner's reconsideration of this claim as corrected and clarified in Section 5. The clarifications are based on material we disclosed in the "Description of the Invention."

**Section 2. Claim Informalities (Examiner's Item 1)**

The examiner objected to nine informalities in the claims. We accept all of these objections and propose the following corrections for consideration; specifically:

Item 1a) Claim 1, Line 1: We propose to cancel Claim 1 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1b) Claim 1, Line 4: We propose to cancel Claim 1 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1c) Claim 2, Line 6: We accept the examiner's objection, and will replace the phrase "the local oscillators" with "local oscillators."

Item 1d) Claim 14, Line 1: We propose to cancel Claim 14 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1e) Claim 14, Line 3: We propose to cancel Claim 14 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1f) Claim 14, Line 4; and Claim 20, Line 5: We propose to cancel Claims14 and 20 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1g) Claim 14, Lines 4-5; and Claim 20, Lines 5-6: We propose to cancel Claims 14 and 20 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1h) Claim 14, Line 8: We propose to cancel Claims 14 and 20 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

Item 1i) Claim 20, Line 3: We propose to cancel Claims 14 and 20 (see Section 4); therefore, if the examiner accepts our cancellation, this correction is not necessary.

**Section 3. Claim Rejections – 35 USC §112 (Examiner's Item 2)**

Claims 1-13, 17, 19, and 21 were rejected by the examiner as being indefinite. We accept this characterization, and offer the following corrections for consideration:

Item 2a) In Claim 1, Line 1, the claimed limitation "A method and system" is ambiguous, as pointed out by the examiner. We propose to cancel Claim 1 for this and other reasons (see Section 3); therefore, if the examiner accepts our cancellation, no further correction is not necessary.

Item 2b) In Claim 2, Line 2, the claimed limitation "The implementation" is ambiguous, as pointed out by the examiner. We propose the following corrected version of Claim 2 for consideration. (The version below also includes corrections described later in Section 5, as well as correction of informalities as described in Section 2 above).

**(2) ~~The implementation of a~~ A system ~~as claimed in (1)~~ for determining the coarse and fine locations of an object, consisting ~~through the use~~ of the following elements:**

**(a) Four or more antennas, arranged in two or more closely spaced pairs dispersed in or around ~~the~~ an area to be covered;**

**(b) Downconvertors or receivers attached to each of the antennas, with ~~the~~ local oscillators of the downconvertors in all the receivers derived from a single reference;**

**(c) Phase locked loops to stabilize and reject noise in the downconverted signals;**

**(d) Phase detectors to determine the phase difference between the received signal in each pair of antennas, providing coarse location through intersection of the directions of arrival;**

**(e) Phase detectors to determine the phase difference between the received signal in antennas not in the same pair, providing a set of intersections of loci of constant phase difference;**

**(f) Resolution of the fine location through selection among the intersections of loci of constant phase difference, based on the coarse location obtained in (d);**

**(g) A transmitter in the object to be tracked.**

Item 2c) In Claims 3-13, the claimed limitation "The application" is ambiguous, as pointed out by the examiner. We propose the following corrections for consideration:

**(3) ~~The application of the radiolocation system in claim 1 or 2, or any other radiolocation scheme, to providing~~ The system of claim 2, wherein the resulting location data is used to provide a real time display of ball location or player location in sporting events.**

**(4) ~~The application of a radiolocation system as in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used to provide a display of the ball location, player location, or other game piece location, in sporting events, in order to enhance spectators' enjoyment and to aid trainers, players, and officials either in ~~accurately determining~~ accurate determination of the ball's location and motion, ~~and/or~~ or generation of game statistics, or both.**

**(5) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for airport surveillance or for monitoring the entry of airplanes to wrong runways.**

**(6) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for childcare facility or prison surveillance.**

**(7) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for accurate football game officiating.**

**(8) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for golf player club selection assistance.**

**(9) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for hockey puck location.**

**(10) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for tennis ball location.**

**(11) ~~The application of the radiolocation system in claim 1 or 2~~ The system of claim 2, wherein the resulting location data is used for baseball game playing, ~~and/or~~ , officiating ~~and/or,~~ and generation of statistics.**

**(12) ~~The application of the radiolocation system in claim 1 or 2,~~The system of claim 2, wherein the resulting location data is used for viewer enhancement.**

*NOTE: We propose to cancel this claim, therefore, if the cancellation is accepted by the examiner this correction is not necessary.*

**(13) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for monitoring of subjects in an area with defined boundaries.**

d) In Claims 19 and 21, the claimed limitation "The application" is ambiguous, as noted by the examiner. We propose to cancel claims 14-21, therefore, if this cancellation is acceptable to the examiner, no further correction is necessary.

e) In Claim 3, the phrase "or any other radiolocation scheme" renders the claim indefinite, as noted by the examiner. We propose to delete this phrase, as shown in the corrected version of claim 3 in part 2(c) above.

f) In Claim 4 and in Claim 11, the expression "and/or" is ambiguous, as noted by the examiner. We propose to correct this ambiguity by rewording claim 4 and changing "and/or" to "and" in claim 11. The corrected versions are shown in part 2(c) above.

g) Claim 17 recites the limitation "the device" without sufficient antecedent, as noted by the examiner. We propose to cancel Claim 17; therefore, if this cancellation is acceptable to the examiner, no correction is required.

**Section 4. Claim Rejections – 35 USC §103(a) (Examiner's Items 3, 4, and 5)**

We were unaware of King, Jr (US 2003/0054905), since the publication date was after the date of our initial application, and we thank the examiner for bringing this prior art to our attention. As a consequence of this prior art, we propose to cancel several of our claims, and add clarifications which further narrow several others.

Item 4a) We agree with the examiner that Claim 1 is unpatentable over King, therefore, *we request cancellation of Claim 1.*

Item 4b) We agree with the examiner that our Claims 3 and 4, as they refer to Claim 1, are unpatentable over King. We propose to delete the reference to Claim 1 in Claims 3 and 4, to make it clear that Claims 3 and 4 refer only to ball location determined using the system in Claim 2.

Item 4c) We agree with the examiner that our Claims 5-13, as they refer to Claim 1, are unpatentable over King. We propose to delete the reference to Claim 1 in Claims 5-11 and 13, to make it clear that Claims 5-11 and 13 refer only to location systems based on the system in Claim 2.

Item 5) We agree with the examiner that our Claims 14-21 are unpatentable over King. *Therefore, we request cancellation of claims 14-21.*

Item 5a) We agree with the examiner that our Claims 14-15 are unpatentable over King. *Therefore, we request cancellation of claims 14-15.*

Item 5b) We agree with the examiner that our Claims 16-18 are unpatentable over King. *Therefore, we request cancellation of claims 16-18.*

Item 5c) We agree with the examiner that our Claim 19 is unpatentable over King. *Therefore, we request cancellation of claim 19.*

Item 5d) We agree with the examiner that our Claims 20-21 are unpatentable over King. *Therefore, we request cancellation of claims 20-21.*

**Section 5. Claim Rejections – 35 USC §103(a) (Examiner's Item 6)**

The examiner rejected Claim 2 as being unpatentable over King (US 2003/0054905) in view of Richards (US Patent 6,111,536) and Zelmanovich (US Patent 6,347,229). We agree that the way we worded Claim 2 does not sufficiently distinguish how our invention is distinct from that of Richards and Zelmanovich. However, the material we

disclosed in the "Description of Invention" makes clear several key differences, and we respectfully request that a clarified version of Claim 2, incorporating these differences, be reconsidered by the examiner.

- The system described by Zelmanovich uses several pairs of antennas, phase detectors, and . By using the azimuthal direction information from each pair of antennas, the location is triangulated. This is similar to parts (a) through (d) in our Claim 2; however, part (e) of our original Claim 2, the phase comparison between antennas in different pairs, is missing from Zelmanovich. This is a critical portion of the system, since it provides finer resolution (for a given phase accuracy) than can be obtained through triangulation alone. The phase difference between antennas in different pairs changes much more rapidly than that between two antennas in the same pair when the object under consideration is moved. By finding the set of intersections of loci of constant phase difference, and selecting from among these based on the coarse triangulation, greatly improved sensitivity is obtained. In the new version of Claim 2, we specifically state that the phase difference between antennas within a pair is used for direction of arrival and coarse location, and phase difference between antennas from different pairs is used to obtain constant phase loci, and that the coarse data is then used to select among the intersections of these loci.
- The system described by Richards provides coarse and fine distance measurement, but works on a completely different principle from our invention, which provides location. In particular:
  - Richards' system uses time domain time-of-flight to determine coarse distance with a single receiver/antenna, whereas our system uses phase measurement to determine direction of arrival at each antenna pair, for a number of antenna pairs. Thus, Richards' system does not incorporate limitations (a) and (d) in our Claim 2.
  - Richards' system requires transceivers with pulse modulated waveforms, on the two objects for which distance is to be measured. Our system requires only a transmitter on the object to be tracked, with no requirement

for modulation, on the object to be tracked, and only receivers in the locating system. We added limitation (g) to make this more distinct in our Claim.

- Richards' system does use phase measurement to determine fine distance; but by resolving I and Q components from a single antenna. We resolve fine distance by examining the phase difference between two completely separate antennas and receivers, as stated in limitation (e) of Claim 2. This is a critical distinction, because Richard's system depends on either phase coherent reference or time synchronization between two transceivers, including one on the object to be tracked, whereas our system needs only local oscillator synchronization between the receivers in the locating sytem (as specified in our limitation (b) in Claim 2), and no synchronization with the transmitter.
- The system described by King uses location by triangulation. Richards' fine distance system could improve the accuracy of King's distance from a particular receiving station, and thus King's triangulation, and thus improve accuracy of the location; however, the fine location part of our system does not rely on an improved distance measurement from any individual receiving station (i.e. pair of antennas), or on triangulation at all, which in only used in the coarse step, but instead on the relative phase between two different receiving stations (i.e two antennas selected from different pairs). We added language to limitations (d) and (e), plus limitation (f) to further clarify and limit the distinction between the coarse and fine parts, and how they are obtained.

To summarize this section, we believe that the patents and applications of King, Richards, and Zelmanovich, whether taken together or separately, do not incorporate all the elements of the system in Claim 2, particularly part (e). Moreover, none of the three patents/applications address the particular method for coarse/fine location we specify in (d) and (e), particularly when the further limitations of (f) and (g) are added for clarification. We do acknowledge that this was not made completely clear in the original wording.

**Section 6 – Cited References and Other Corrections**

The examiner noted one reference (Amorai-Moriya et al., 6,316,934) that we should have included. We agree that this was an oversight and will add this reference, as well as King (2003/0054905), Richards (6,111,536), and Zelmanovich (6,347,229). However, we request permission to defer these corrections and typographical/grammatical corrections to the Description of Invention until it becomes clearer whether any of our claims are likely to be allowed.

Respectfully Submitted:

Eugene Britto John, Inventor

Heinrich Foltz, Inventor

# List of Claims, Revised

Submitted April 17, 2002

**What is claimed is:**

~~(1) A method and system to determine the coarse and fine location of objects in a radiolocation system, through the combined use of direction of arrival of signals at each of several widely spaced reception points, using closely spaced antennas at each point, with relative phase between the received signals at the widely spaced points.~~ *(Claim Cancelled.)*

(2) ~~The implementation of a~~ A system ~~as claimed in (1)~~ for determining the coarse and fine locations of an object, consisting ~~through the use~~ of the following elements:

(a) Four or more antennas, arranged in two or more closely spaced pairs dispersed in or around ~~the~~ an area to be covered;

(b) Downconvertors or receivers attached to each of the antennas, with ~~the~~ local oscillators of the downconvertors in all the receivers derived from a single reference;

(c) Phase locked loops to stabilize and reject noise in the downconverted signals;

(d) Phase detectors to determine the phase difference between the received signal in each pair of antennas, providing coarse location through intersection of the directions of arrival;

(e) Phase detectors to determine the phase difference between the received signal in antennas not in the same pair, providing a set of intersections of loci of constant phase difference;

(f) Resolution of the fine location through selection among the intersections of loci of constant phase difference, based on the coarse location obtained in (d);

(g) A transmitter in the object to be tracked.

(3) ~~The application of the radiolocation system in claim 1 or 2, or any other radiolocation scheme, to providing~~ The system of claim 2, wherein the resulting location data is used to provide a real time display of ball location or player location in sporting events.

(4) ~~The application of a radiolocation system as in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used to provide a display of the ball location, player location, or other game piece location, in sporting events, in order to enhance spectators' enjoyment and to aid trainers, players, and officials either in ~~accurately determining~~ accurate determination of the ball's location and motion, ~~and/or~~ or generation of game statistics, or both.

(5) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for airport surveillance or for monitoring the entry of airplanes to wrong runways.

(6) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for childcare facility or prison surveillance.

(7) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for accurate football game officiating.

(8) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for golf player club selection assistance.

(9) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for hockey puck location.

(10) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for tennis ball location.

(11) ~~The application of the radiolocation system in claim 1 or 2~~ The system of claim 2, wherein the resulting location data is used for baseball game playing, ~~and/or~~ , officiating ~~and/or,~~ and generation of statistics.

~~(12) The application of the radiolocation system in claim 1 or 2 for viewer enhancement.~~ *(Claim Cancelled.)*

(13) ~~The application of the radiolocation system in claim 1 or 2,~~ The system of claim 2, wherein the resulting location data is used for monitoring of subjects in an area with defined boundaries.

~~(14) A system for three dimensional location of objects in a bounded area, the system comprising:~~

~~(a) a sensor, wherein a sensor is coupled to each object to be monitored;~~

~~(b) at least two or more antenna configured to monitor the sensors in a bounded area;~~

~~(b) a receiver for receiving signals from the sensors via the antennas;~~

~~(c) a computer with memory operating pursuant to software capable of receiving the signals from the receiver and determining the location of the sensors in the bounded area.~~ *(Claim Cancelled.)*

~~(15) The system according to claim 14, wherein the sensor is capable of transmitting a RF signal.~~ *(Claim Cancelled.)*

~~(16) The system according to claim 14, wherein the sensor is a passive device.~~ *(Claim Cancelled.)*

~~(17) The system according to claim 14, wherein the device is a magnet generating a magnetic field.~~ *(Claim Cancelled.)*

~~(18) The system according to claim 14, wherein the sensor comprises an R-L circuit or an R-C circuit or an R-L-C circuit.~~ *(Claim Cancelled.)*

~~(19) The application of a radiolocation system as claimed in (14), to provide a real time display of the ball location, player location, or other game piece location, in sporting events, in order to enhance spectators' enjoyment and to aid trainers, players, and officials in accurately determining the ball's location and motion.~~ *(Claim Cancelled.)*

~~(20) A system for three dimensional location of objects in a bounded area, the system comprising:~~

~~(a) a device capable of being tracked, wherein a device capable of being tracked is coupled to each object to be monitored;~~

~~(b) at least two or more antenna configured to monitor the devices in a bounded area;~~

~~(c) a receiver for receiving signals from the devices via the antennas;~~

~~(d) a computer with memory operating pursuant to software capable of receiving the signals from the receiver and determining the location of the devices in the bounded area.~~ *(Claim Cancelled.)*

~~(21) The application of a radiolocation system as claimed in (20), to provide a real time display of the ball location, player location, or other game piece location, in sporting events, in order to enhance spectators'~~

~~enjoyment and to aid trainers, players, and officials in accurately determining the ball's location and motion.~~ *(Claim Cancelled.)*